METHOD AND ARRANGEMENT FOR PROTECTING A CHIP AND CHECKING ITS AUTHENTICITY

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The invention relates to a semiconductor device provided with a circuit, a security layer that covers the circuit and a security element comprising a local area of the security layer and a sensor.

The invention also relates to a carrier provided with a semiconductor device and a card reader.

The invention further relates to a method of initializing and a method of checking the authenticity of the semiconductor device.

Such a semiconductor device and such a carrier are known from EP-A 300864. The security element of the known device is a capacitor with as its sensor two capacitor electrodes that are coupled capacitively together by the security layer. The device comprises a plurality of security elements by preference. On checking the authenticity of the device, a measured voltage is compared with a calculated reference voltage. If there is a difference, the authenticity is not recognized. The carrier on which the device is present is a smartcard.

It is a disadvantage of the known device that the security elements can be circumvented. The security elements may be replaced by other structures with the same capacitance which leave the underlying circuit free. Furthermore, the removal of the security layer and the electrodes cannot be detected if the electrodes and the security layer are reapplied afterwards. Such removal is done in order to look at, to probe electrically, and/or to modify the circuit.

It is therefore a first object of the invention to provide a semiconductor device of the kind mentioned in the opening paragraph, of which removal of the security layer can be detected afterwards.

It is a second object of the invention to provide a carrier with an improved detection of hacking.

The first object is realized in that:

- the security layer comprises embedded magnetic particles, and
- the sensor is a magnetic sensor capable of measuring a magnetic property of the security layer.

As was explained above, only the magnetic particles whose magnetization can be permanently fixed can be measured directly. For other magnetic particles it is necessary to apply an external magnetic field before measuring. This external field is preferably generated in the card reader. In order to have a calibrated actual value, it is measured as the difference between an off-state value at a standard, preferably zero external field, and an on-state value at the external magnetic field.

If the magnetic particles or at least a proportion thereof contain a hard-magnetic material, a preliminary treatment is necessary to remove any existing magnetization in the magnetic particles in the direction substantially perpendicular to the security layer. Such a preliminary treatment may be a degaussing treatment, such as described above in more detail.

If the magnetic particles or at least a proportion thereof contain a soft-magnetic material, a relaxation measurement maybe performed, comprising the steps of:

- generating an external magnetic field to induce a magnetization in the magnetic particles substantially perpendicular to the security layer;
- measuring a first and a second value before the particles of the softmagnetic particles are relaxed to their saturation magnetization, and
- determining the actual value of the impedance of the security element as the difference between the first and the second value.

This relaxation measurement offers a specific response. The number of values to be measured depends on the relaxation time of the soft-magnetic material, which is known per se. The actual value is determined as the difference between the second and the first value in order to correct for drift effects. If a large number of values is measured, the difference can be calculated between the measured value and the first value, or between consecutive values. The measurement can be optimized in that, after measurement of the first and the second value, an external magnetic field is generated in the opposite direction and further values are measured.

BRIEF DESCRIPTION OF DRAWINGS

These and other aspects of the semiconductor device and the methods of initializing it and checking its authenticity according to the invention will be further explained with reference to the drawings, in which:

Fig. 1 is a diagrammatical cross-section of the semiconductor device;